

**EFFECTIVENESS OF VARIOUS OUTRIGGER
SYSTEMS UNDER DIFFERENT STRUCTURAL
MATERIALS FOR A REINFORCED CONCRETE HIGH
RISE BUILDING SUBJECTED TO WIND LOADS**

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Degree of Master of Science

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Dissertaion submitted in partial fulfillment of the requirements for the
degree Master of Science in Civil Engineering

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June 2022

Declaration

I declare that this is my own work and this dissertation does not incorporate without acknowledgment any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Name of the supervisor: Prof. (Mrs.) J. C. P. H. Gamage

Signature of the supervisor:

Date:

Abstract

The structural efficiency of tall buildings significantly relies on the lateral stiffness of building and its resistance capacity against lateral loads. However, when the structure becomes taller and slender, the building responses under wind loads become more pivotal as it reduces structural stiffness of building. Therefore outrigger and belt truss structural systems that connect through the central core system and the most exterior columns in building are often introduced in high rise structures to provide adequate lateral stiffness in order to control the wind deflection and drift criteria in acceptable limits. Most research works are limited to building with outrigger systems of concrete material, consisting of simple square and rectangular shaped building plan layouts having vertical regularity. Only few studies were based on a single model under different patterns of outrigger structural systems to identify the optimum outrigger structural system when outrigger arrangements are varied. This study aims to bring a broader understanding of both conventional outrigger & virtual outrigger systems by identifying the most efficient lateral load resisting outrigger system for a reinforced concrete high rise building under different outrigger structural materials of concrete, steel and composite by comparing the performance for three different outrigger arrangements; only outriggers, only belt truss and combination of both outrigger and belt truss when subjected to wind loads while their positions remain constant for all the three cases. The structural performance was evaluated based on building frequency, wind induced lateral displacement at top storey and inter storey drift ratio and results demonstrate that addition of outriggers and belt trusses of different structural materials have significantly enhanced the structural performance of building against wind action and the best form of outrigger structural arrangement is varied based on each structure material.

Keywords: Outriggers, Reinforced Concrete Building, Wind Load, Lateral Displacement, Inter Storey Drift

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List of Abbreviations

Abbreviation	Description
CTBUH	Council on Tall Building and Urban Habitat
UAE	United Arab Emirates
USA	United States of America
RC	Reinforced Concrete
3D	3 Dimensional
MEP	Mechanical, Electrical & Plumbing

List of Appendices

Appendix	Description
Appendix- A	Wind Loads Calculation